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## **Knowledge Level of Teachers of the d/Deaf and Hard of Hearing to Develop Phonological Awareness of Students with Cochlear Implants**

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### **ABSTRACT**

The number of bilateral cochlear implantations is increasing globally. The goal of this study is to determine the extent to which teachers of the d/Deaf and hard (d/Dhh) of hearing possessed the skills and ability necessary to develop phonological awareness on the part of d/Dhh students who have cochlear implants. Further, the study explored the differences in the teachers' levels of knowledge of the skills based upon gender, qualifications, and teaching experience. The participants were composed of purposively selected 78 elementary school teachers in different teaching settings in Saudi Arabia. The data were collected using a survey questionnaire, and were analyzed via descriptive statistics and multiple regression analysis to address the exploratory research questions because of their flexibility with respect to the type of data and the examination of complex associations. The results revealed that teaching phonological awareness skills had a mean percentage agreement of 77%, which indicated that teachers of the d/Dhh considered phonological awareness highly important for the skills necessary to develop sound recognition in students with cochlear implants. Further, the teachers' mean percentage agreement for the six strategies of classroom facilities varied.

**Keywords:** d/Deaf and Hard of Hearing, elementary students, phonological awareness, cochlear implants

### **1. INTRODUCTION**

The field of deaf education has witnessed considerable changes over the past decades. Technological advances changed certain features of the field of deaf education when cochlear implants were approved. The U.S. Food and Drug Administration (FDA) approved the use of cochlear implants for adults, and they were approved for use with children in 1990. In 2000, the FDA approved the Nucleus 24 Cochlear Implant for children with profound hearing loss as young as 12 months of age (Park et al., 2021). This remarkable piece of technology allows children and adults with little to no residual hearing to learn how to speak and communicate verbally without the need to use sign language (Ertmer, 2002).

Children with cochlear implants often obtain access to auditory inputs and acquire spoken language a minimum of one year later than their hearing peers. Several studies have found that children with cochlear implants performed significantly more poorly on receptive vocabulary tasks than those with normal hearing (Ambrose, 2009; Bell et al., 2019), while Nittrouer et al. (2018) demonstrated that children with normal hearing performed better than those with cochlear implants on expressive vocabulary tasks. In addition, Schorr et al. (2008) research and Lund's (2016) meta-analysis of 12 studies found that children with cochlear implants performed significantly worse on both receptive and expressive vocabulary tasks than their hearing peers. In contrast, some studies have shown that children with cochlear implants did not perform substantially differently on receptive and expressive vocabulary tests compared to their hearing counterparts (Luckhurst et al., 2013; Wechsler-Kashi et al., 2014). In addition, Vermeulen et al. (2007) conducted a study on reading comprehension with two groups of 16 children, one of prelingually d/Dhh children with cochlear implants and another with normal hearing. The findings indicated that compared to children with typical hearing, d/Dhh children with cochlear implants achieved higher reading comprehension levels than those without implants. Archbold et al. (2008) studied 105 d/Dhh students ages 11 to 14 years who had cochlear implants before the age of seven. Their reading abilities were assessed in the areas of vocabulary, sequencing, and sentence comprehension. The results showed that children who received cochlear implants before they were three-and-a-half-years old had a reading level that was normal for their age. These discrepant results may be attributable to the wide range of ages represented in these research populations, which resulted in greater variances that masked group differences.

The increased use of cochlear implants in d/Dhh children has highlighted the requirement for teachers to be prepared to meet these students' needs. The integration of d/Dhh students with cochlear implants into mainstream classrooms has increased in recent years, and led to a growing need for teachers to have the knowledge and skills

to support these students effectively. Morishita (2019) conducted a systematic review to assess the need for teachers of the d/Dhh to receive audiology instruction and to identify the best practices to prepare these teachers. The results of the review showed that teachers of the d/Dhh often lack the knowledge and skills needed to support students with cochlear implants effectively. The results also showed that teacher training programs that include audiology instruction can improve teachers' knowledge and skills significantly and lead to improved outcomes for students with cochlear implants. Further, the author found that it is necessary for teachers to have ongoing professional development opportunities to remain abreast of the latest advancements in cochlear implant technology and continue to improve their skills in supporting d/Dhh students. Overall, the study highlights the importance of audiology instruction for teachers of the d/Dhh, and the need for tailored teacher training programs that include hands-on training and ongoing professional development opportunities.

Students' academic performance can be enhanced when teachers participate in extensive professional development programs (Alqraini, 2022). Thus, students who are d/Dhh require and deserve highly qualified specialists to provide both direct and indirect interventions. This study's objective was to determine the extent to which teachers of the d/Dhh possessed the skills and ability necessary to develop phonological awareness and speech perception on the part of d/Dhh students who have cochlear implants. The study sought answers to the following questions:

- What is d/Dhh teachers' level of ability to develop phonological awareness in d/Dhh students who have cochlear implants?
- Are there differences in the level of ability to develop phonological awareness based upon gender, qualifications, and teaching experience?

## 2. METHODS

The purpose of this study was to scrutinize the levels of knowledge of teachers of the d/Dhh of the skills necessary to develop phonological awareness on the part of d/Dhh students who have cochlear implants, as well as to explore differences in their levels of knowledge based upon gender, qualifications, and teaching experience. To achieve these objectives, the following path was followed.

### 2.1. Research Design

In the study, quantitative method was adopted based on a survey questionnaire. Quantitative method focuses on measurements via statistical, mathematical, or numerical analysis of data collected through surveys, questionnaires, etc. (Subudhi, 2016).

### 2.2. Participants

The participants in this study comprised 78 elementary school teachers of d/Dhh students with cochlear implants in different settings in Saudi Arabia. The primary approach in public schools where d/Dhh students are taught in mainstream classes is oral education, which is applied with hard of hearing or d/Dhh students who have cochlear implants (Alqraini, 2022).

Teachers of d/Dhh students were recruited using a purposeful sample strategy based upon the following three criteria: (1) Teachers must teach courses in literacy skills; (2) all of the students must have cochlear implants, either unilateral or bilateral, and (3) all teachers must teach at the elementary level.

### 2.3. Data Collection and Analysis of the Data

Because this research was empirical, we opted to use a questionnaire to collect the data. The questionnaire addresses the issues of the levels of knowledge of teachers of the d/Dhh of the skills necessary to develop phonological awareness and speech perception with d/Dhh students who have cochlear implants. Descriptive statistics were calculated, and a multiple regression analysis was performed to address the exploratory research questions because it offers flexibility with respect to the type of data and the examination of complex associations (Rahman et al., 2020). Further, data were collected to obtain more insights into the importance of demographic profiles in predicting the use of various learning strategies.

The questionnaire consisted of six demographic questions: teacher's gender; work experience; qualifications; teaching context; number of training courses attended, and city of residence. A five-point Likert scale that ranged from 1 (Strongly agree) to 5 (Strongly disagree) was used to respond to the 18 statements about skills or measurement items, which consist of 12 Teaching Skills Strategies and 6 strategies of classroom facilities. The questionnaire's content and face validity were evaluated with the use of experts' opinion on its clarity, language, appearance, and convenience of use. Two academic experts reviewed the survey and suggested certain changes. Further, they recommended other items that would be helpful to include in the questionnaire. The questionnaire's reliability was assessed, and a test for response bias (Field, 2009) indicated that there was no such bias in the dataset. Further, several missing data were treated by the Expectation-Maximisation method (Field, 2009). The internal consistency of the dataset's reliability was confirmed based upon Cronbach's alpha values above .7 for all of the teaching skills strategies (CA = .77) (Ringle & Sarstedt, 2016).

### 3. FINDINGS

Findings of the study are stated using related tables and figures as in the following.

#### 3.1. Participants

**Table 1: Demographic Profile**

Demographic Profile		Frequency	Percent
Gender			
	Male	46	59.0
	Female	32	41.0
	Total	78	100.0
Work experience			
	Less than 5 years	17	21.8
	5-9 years	15	19.2
	10 years or more	46	58.9
Teaching Context			
	Lower elementary school grades (first to third grades)	23	29.5
	Higher elementary school grades (fourth to sixth grades)	19	24.4
	Public school mainstream classes	29	37.2
	Al-Amal institutes for Deaf	5	6.4
	Others	2	2.6
Number of training courses			
	None	24	30.8
	One	14	17.9
	Two	21	26.9
	Three	12	15.4
	Four or more	7	9.0
Qualifications			
	Diploma in Education of the Deaf and Hard of Hearing	5	6.4
	Bachelor of Special Education in Deaf and Hard of Hearing	41	52.6
	Master's in Special Education	31	39.7
	PhD in Special Education	1	1.3
City of residence			
	Riyadh	40	51.3
	Jeddah	7	9.0
	Other 4 participants	31	39.7

As shown in Table 1, 59% of the participants are male, and 58.9% have ten or more years of teaching experience, 53.9% of the participants work in elementary schools, 52.6% have a Bachelor's degree in Special Education specialized in Deaf and Hard of Hearing, and 41% have a postgraduate degree. Further, the data were collected from teachers in more than 20 cities.

### 3.2. Descriptive Statistics

**Table 2: Teaching Phonological Awareness Skills**

Teaching Phonological Awareness Skills (TPAS)	Mean	SD	Agreement %
I have sufficient skill to apply the strategy of “isolating sounds”, which is used to understand the phonemes of the word.	4.32	.83	86
I have sufficient skill to apply the strategy of “recognizing sounds”, which is used to identify similar sounds in different words.	4.26	.80	85
I have sufficient skill to apply the strategy of “phonological classification”, which is used to identify the word with an inconsistent sound in a group of words with similar sounds.	4.17	.93	83
I have the skill to apply the “mixing of sounds” strategy, which is used to recognize words by distinguishing the audible sounds of separate words.	3.88	.85	78
I have sufficient skill to apply the strategy of “segmentation of sounds”, which used to divide a word into its sounds by referring to it, pronouncing it, or colouring it.	3.71	.91	74
I have the skill to apply the strategy of “deleting the phoneme”, which is used to distinguish the word if one of its sounds is deleted.	3.71	1.01	74
I have sufficient skill to apply the strategy of “phonological homogeneity”, which entails teaching unfamiliar words by using familiar words.	3.92	1.07	78
I have sufficient skill to apply the strategy of “phonological analysis”, which entails teaching the relation between the letter and its sound in familiar words to spell unfamiliar words.	3.64	1.06	73
I have sufficient skill to apply the strategy of “phonological integration”, which entails teaching the relation between the shape of the letter and its sound through reading. Students learn letter shapes and sounds when they encounter certain letters while reading.	3.82	.99	76
I have sufficient skill to apply the “phonetic dictation” strategy, which entails dictating words in an intermittent phonetic form so that students can write the letter forms of these words.	3.77	1.01	75
I am sufficiently skilled to apply the strategy of “phonemic division”, which entails dividing a word into two syllables, regardless of the number of sounds in each syllable.	3.40	1.12	68
I have sufficient skill to apply the “phonemic structure” strategy, which entails teaching students to convert letters into sounds and then combine them to pronounce a whole word.	3.79	.94	76
<b>Mean</b>			<b>77</b>

As shown in Table 2, the mean of the teaching skills of phonological awareness was 77%, which indicated that teachers of the d/Dhh consider them highly important skills necessary to develop phonological awareness of students with cochlear implants. Further, the mean of the skills of “isolating sounds, recognizing sounds and phonological classification” was greater than 83%, while the mean of “phonemic division” was 68%.

### 3.3. Classroom Facilities

**Table 3: Strategies of Classroom Facilities**

Strategies of Class Room Facilities (SCRF)	Mean	SD	Agreement %
Have the skills to make the classroom environment as quiet and noise-free as possible.	4.31	.83	86
Use visual aids extensively to make the teaching material as clear as possible.	4.36	.70	87
Arrange study desks in a U-shape so that students can see the teacher and the blackboard without obstructions.	4.45	.71	89
I have sufficient knowledge about the use and operation of hearing aids.	3.47	1.14	69
The school provides an FM device for use in the classroom.	3.04	1.51	61
The school has support services for the teacher for the success of the teaching process, such as speech therapists and assistive devices.	3.18	1.35	64
<b>Mean</b>			<b>76</b>

Table 3 shows the mean respondent and percentage agreement for the six strategies of classroom facilities. The strategies of “noise-free classroom environment”, “clear teaching materials”, and “U-shape desk arrangement” had percentage agreements above 86% among the teachers with respect to the skills necessary to develop phonological awareness of students with cochlear implants. Meanwhile, the “I have sufficient knowledge about the use and operation of hearing aids”, “The school provides an FM device for use in the classroom”, and “... speech therapists and assistive devices” had a mean below-average agreement of 65%, which indicates that teachers need more practice using the devices and greater assistance from speech therapists. This issue highlights the importance of having frequent supplementary training courses as well as speech therapists’ assistance. To explore the results further based upon the differences in the demographic profiles according to the skills introduced in Tables 2 and 3, Table 4 presents the mean and percentage agreement for each category. For gender, the differences between men and women were low, although women teachers assigned higher importance to the strategies; for example, 75% of men assigned high importance to TPAS, while 80% of women did. Further, for work experience, the results among categories were above average (75-80%). Similarly, for qualifications, the differences among the categories were low and largely above the mean.

### 3.4. Skills and Demographic Profiles

**Table 4: Skills According to Demographic Profiles**

Demographic profile	Mean / % Agreement		
	TPAS	SCRF	Overall
<b>Gender</b>			
Male	3.76	3.78	3.76
	75%	76%	75%
Female	4.02	3.83	3.96
	80%	77%	79%
<b>Work Experience</b>			
Less than 5 years	4.14	3.68	3.98
	83%	74%	80%
5-9 years	3.98	3.77	3.91
	80%	75%	78%
10 years and more	3.73	3.86	3.77
	75%	77%	75%
<b>Qualification</b>			
Diploma in Education of the Deaf	3.77	3.73	3.76
	75%	75%	75%
Bachelor of Special Education	3.94	3.90	3.93

		79%	78%	79%
	Master of Special Education	3.77	3.70	3.74
		75%	74%	75%
	PhD in Special Education	N/A	N/A	N/A

### 3.5. Multiple Regression Analysis of Skills Needed to Develop Phonological Awareness

Multiple regression is an extension of simple linear regression. It is used when one wants to predict the value of the dependent variable “Skills” based upon the value of two or more other variables, in this case, gender, qualifications, and experience as the predictor, explanatory, or regressor variables. Multiple regression was used here to understand whether the skills needed to develop phonological awareness and perception can be predicted based upon gender, qualifications, and experience.

Multiple regression also allows the overall fit (variance explained) of the model and each of the predictors’ relative contribution to the total variance explained to be determined. Further, it makes it possible to distinguish how much of the variation in “skills” overall that gender, qualifications, and experience explains, as well as each independent variable’s relative contribution in explaining the variance. The  $R^2$  is the proportion of variance in the dependent variable “Skills” that the independent variables can explain. Based upon Hair et al. (2010), the criteria of  $R^2$  should be above 19%, and the  $R^2$  values for each model, .24, .26, and .28, respectively, that our independent variables explained were 23.5%, 25.5%, and 27.8%, respectively. Further, based upon the  $F$  (4.39) and the model fit (.04), the regression model overall provided a good fit to the data. Further, as shown in Table 5, the variables were within the range of an acceptable Variance Inflation Factor (VIF)  $< 5$ , in which 5 indicates minor collinearity and a VIF of 10 is considered to indicate major collinearity (Hair et al., 2010).

The beta values (Table 5) indicate the strength of the relation between the dependent and independent variables, and the beta values that Hair et al. (2011) suggested are  $\beta < .2$  is weak;  $.2 \leq \beta \leq .5$  is moderate, and  $.5 < \beta$  is strong). As shown for each model in Table 5, the beta values, which measure the strength of the relation between the “skills” dependent variables and each of the independent variables were moderate and positive in model 1 (.23).

**Table 5: Multiple Regression Analysis**

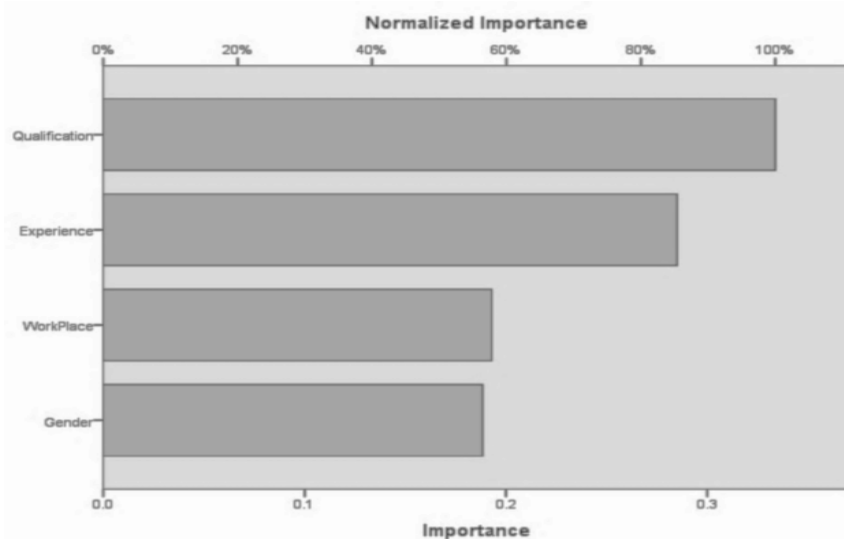
Model	Dependent variable: Skills	Beta	$t$	p-value	95.0% Confidence Interval for B		VIF
					Lower Bound	Upper Bound	
1	(Constant) $R^2 = .23$		25.43	.000	3.29	3.85	
	Gender	.23	2.10	.04	.01	.38	1.00
2	(Constant) $R^2 = 0.255$		18.96	.000	3.30	4.08	
	Gender	.23	2.03	.05	.004	.38	1.01
	Qualifications	-.11	-.93	.36	-.14	.05	1.00
3	(Constant) $R^2 = .28$		13.41	.000	3.32	4.48	
	Gender	.17	1.35	.18	-.07	.36	1.28
	Qualifications	-.10	-.86	.39	-.14	.06	1.01
	Experience	-.12	-.99	.33	-.19	.07	1.28

### 3.6. Statistical Significance of the Independent Variables

The multiple regression analysis was performed to explore the research question, does the level of ability of d/Dhh students who have cochlear implants to develop phonological awareness differ based upon teachers’ gender, qualifications, and teaching experience? Table 5 summarizes the regression results for the three models; the first is based upon gender-independent variables, the second combines gender and qualifications, and the third uses all three independent variables. The statistical significance of each of the independent variables indicates whether the unstandardized (or standardized) coefficients are equal to 0 in the population. If  $p < .05$ , we can conclude that the coefficients differ statistically significantly from 0. The  $t$ -value and corresponding p-value are shown in Table 5. The significant relations associated with “Skills needed to develop phonological awareness” are based upon the effect of the independent variables—gender, qualifications, and experience. The p-value of the 2-tailed test of gender is less than .03 at the 95% confidence interval and is statistically significant, based upon a  $t$ -value above 1.65 of model 1. Consequently, the other independent variables in models 2 and 3 were not statistically significant.

Specifically, model 3 showed that the three demographic variables, gender, qualifications, and experience, did not differ with respect to “Skills”.

To explore the importance of the demographic variables to “Skills” further, a prediction model was run and 70% of the data were used to train the model and 30% to test it. Figure 1 shows the normalized importance of the demographic profiles to the skills.



**Figure 1: Normalized Importance of Demographic Profiles to the Skills**

To determine the significance of the independent variable that predicts the dependent variable “Skills”, the findings in Figure 1 show that teachers’ qualifications were the most important predictor of the skills they needed to develop their students’ phonemic awareness, followed by experience, work context, and lastly, gender.

#### 4. DISCUSSION

As teachers of d/Dhh students demonstrated a mean agreement of 77% with teaching phonological awareness strategies, it was clear that they understood the significance of including these skills in their lessons. Phonological awareness is the ability to hear and manipulate the sounds of spoken language (Alasim & Alqraini, 2020). Therefore, the results showed that the majority of teachers had adequate knowledge about the way to teach phonological awareness to d/Dhh children with cochlear implants. These results are consistent with those in Alqraini’s study (2022), which indicated that 75%-79% of d/Dhh teachers agreed that they used at least one strategy to teach phonological awareness to their deaf students, and obviously realize the value of inculcating it in their students. d/Dhh Children can learn phonological awareness with the help of explicit instruction and visual aids, as several studies have shown (Narr, 2008; Trezek et al., 2007; Trezek & Wang, 2006; Trezek & Malmgren, 2005). Two separate studies (Trezek & Wang, 2006; Trezek et al., 2007) have also shown that d/Dhh youngsters benefit greatly from exposure to spoken phonology to enhance their reading abilities. According to their findings, phonological awareness helps students acquire a larger vocabulary in both spoken and written English. Further, the studies demonstrated the significance of phonological awareness, particularly phonemic awareness, in the development of word recognition abilities and the comprehension of the association between spoken and written English (Trezek & Malmgren, 2005).

The respondents’ agreement with the six strategies of classroom facilities were those of “noise-free classroom environment”, “clear teaching materials”, and “U-shape desk arrangement”, which showed percentage agreements above 86% among the teachers with the skills necessary to develop phonological awareness of students with cochlear implants. The “I have sufficient knowledge about the use and operation of hearing aids”, “The school provides an FM device for use in the classroom”, and “The school has support services for the teacher for the success of the teaching process, such as speech therapists and assistive devices” had a below-average mean agreement of 65%, which indicates that teachers need to understand the way to use and operate hearing aids and more practice using assistive devices. This issue highlights the importance of having frequent supplementary training in these areas. This is consistent with what the teachers in Alqraini’s study (2022) reported, who indicated that they need more support from senior teachers in the field of d/Dhh to manage their classrooms effectively. According to Luckner (2010), teacher preparation programs do not educate teachers effectively to teach reading and manage their classrooms, which leaves them with little knowledge and experience in d/Dhh teaching that is reflected in the students’ suboptimal performance.



## 5. CONCLUSION

Cochlear implants for the d/Dhh who have severe to profound hearing loss offer a way for these individuals to access sounds. The number of bilateral cochlear implantations is rising globally (Sivonen et al., 2021), which makes it imperative for teachers to know how to enhance the phonological awareness of d/Dhh students who have cochlear implants. Thus, teachers of the d/Dhh are required to use various learning strategies that help children in the classroom achieve their learning goals.

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